Report Documentation Page

Form Approved
OMB No. 0704-0188

1. REPORT DATE	2. REPORT TYPE	3. DATES COVERED
2010		**00-00-2010 to 00-00-2010**

4. TITLE AND SUBTITLE	5a. CONTRACT NUMBER
Numerical Investigation of Nonlinear Internal Wave Generation and Breaking in Straits	5b. GRANT NUMBER
	5c. PROGRAM ELEMENT NUMBER
6. AUTHOR(S)	5d. PROJECT NUMBER
	5e. TASK NUMBER
	5f. WORK UNIT NUMBER
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) **Princeton University,Atmosphere and Ocean Sciences Program,Sayre Hall, Forrestal Campus, 300 Forrestal Drive,Princeton,NJ,08544**	8. PERFORMING ORGANIZATION REPORT NUMBER
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)	10. SPONSOR/MONITOR'S ACRONYM(S)
	11. SPONSOR/MONITOR'S REPORT NUMBER(S)

12. DISTRIBUTION/AVAILABILITY STATEMENT
Approved for public release; distribution unlimited

13. SUPPLEMENTARY NOTES

14. ABSTRACT

15. SUBJECT TERMS

16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a. REPORT **unclassified**	b. ABSTRACT **unclassified**	c. THIS PAGE **unclassified**	**Same as Report (SAR)**	**2**	

Numerical Investigation of Nonlinear Internal Wave Generation and Breaking in Straits

Sonya Legg
Atmosphere and Ocean Sciences Program, Princeton University, Sayre Hall, Forrestal Campus, 300 Forrestal Drive, Princeton NJ 08544
phone: (609) 253-6852 fax: (609) 987-5063 email: Sonya.Legg@Noaa.gov

Award Number: N000140910832

LONG-TERM GOALS

My long-term goals are to develop a physical understanding of the processes which lead to mixing in the ocean, with the aim of using this understanding to develop parameterizations of mixing suitable for global and regional models, and applying such models to societally relevant problems. A particular focus is the mixing induced by tidal flow over topography, and mixing induced by breaking nonlinear internal waves.

OBJECTIVES

The scientific objectives of this study are to explore internal waves generated by tidal flow through straits in the region close to the sill. Our geographic focus will be the Luzon Straits. A particular scientific focus will be nonlinear overturning and breaking within the straits leading to mixing and modification of the wave field. One possibility which we will examine is whether transient internal hydraulic jumps are possible in the Luzon Straits, whether these jumps are released to propagate toward the topography as internal bores when the flow relaxes, and whether the bores lead to local mixing. We will explore the details of the Luzon Strait topography to identify locations particularly conducive to local overturning processes. We will examine how local mixing modifies the character of the internal waves that propagate away from the topography, for example their vertical and horizontal scales. We will also examine the sensitivity of the nonlinear wave response to the local stratification near the sill, and the ambient geostrophic currents. To summarize, our goals are to (a) examine the dependence of nonlinear features and local breaking at the generation site on topographic shape and stratification; (b) evaluate the impact of topographic shape and stratification on the lengthscales and amplitude of the internal wave response to tidal forcing; (c) examine the impact of seasonal variations in stratification and geostrophic currents on the lengthscales and amplitude of the internal tides.

APPROACH

We will employ the nonhydrostatic MITgcm in both 2- and 3-dimensions to carry out simulations of increasing complexity, focusing the resolution on the regions close to the sill where overturning is most likely to occur. The MITgcm is well-suited for this study, having been used for numerous study of nonlinear internal tides (e.g. Legg and Klymak, 2008). Typical resolutions near the sill will be O(100m) in the horizontal and O(10km) in the vertical, although higher resolutions may be used if needed to capture the features of interest. We will use local computing resources for initial

calculations, and we are in the process of applying for Navy supercomputing resources for larger calculations. Initial simulations will focus on providing guidance for the main field program to take place in 2011. The goal will be to identify the locations where mixing is important, and hence where observations would be most interesting. Following the field program, simulations will be carried out to help in interpretation of the observations, with increasing complexity, beginning with 2D simulations with horizontally uniform stratification, and proceeding to 3D simulations with complex realistic topography and ambient stratification. We will collaborate closely with Jody Klymak, and Maarten Buijsman, a postdoctoral researcher based at Princeton, will carry out much of this work. We will also communicate closely with observationalists involved in the Luzon Straits field experiment.

WORK COMPLETED

Funding was awarded in spring of 2009. A postdoctoral search was carried out beginning on October 2009, but a suitable postdoctoral candidate was only finally identified in March 2010, and that candidate, Maarten Buijsman, was only able to take up this position in September 2010. Legg is only receiving one month's salary per year for this project. Progress has therefore been limited to setting up the MITgcm for initial calculations. Buijsman is now making rapid progress with configuration of the model for Luzon straits calculations, and we expect to be able to contribute results to the planning of the 2011 field program.

RESULTS

Nothing to report at present.

IMPACT/APPLICATIONS

Nothing to report at present.

RELATED PROJECTS

This work is a component of the Internal Waves in Straits Experiment. We expect to work closely with other IWISE researchers, particularly Jody Klymak. The work is also related to a recently proposed NSF climate process team on internal-wave driven mixing (PI Jen MacKinnon), with which Legg is collaborating.

REFERENCES

Legg S., and J. Klymak, 2008: Internal Hydraulic Jumps and Overturning Generated by Tidal Flow over a Tall Steep Ridge. Journal of Physical Oceanography, v38, 1949-1964.